

LA-UR-20-29415

Approved for public release; distribution is unlimited.

Title: Capability Based Deterrence

Author(s): Martz, Joseph Christopher

Intended for: Online lecture for NNSA, NA-80 (Counterproliferation) as well as internal seminars at Los Alamos

Issued: 2020-11-17

Disclaimer:

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by Triad National Security, LLC for the National Nuclear Security Administration of U.S. Department of Energy under contract 89233218CNA000001. By approving this article, the publisher recognizes that the U.S. Government retains nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

Capability Based Deterrence

Joe Martz
Los Alamos National Laboratory

April 2019

Excerpts from
LA-UR 11-05592
LA-UR 10-03518
LA-UR-17-26362



Capability Based Deterrence Outline

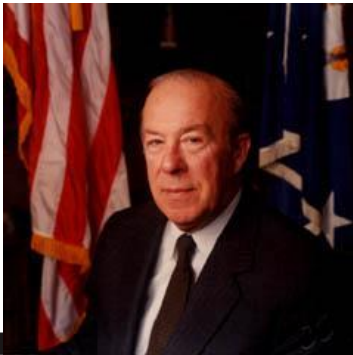
- 1) What is Capability Based Deterrence and its implementation in policy
- 2) Assessment of Capability Based Deterrence compared to other options
- 1) Characteristics of an effective Capability Based Deterrent

Part 1:

What is Capability Based Deterrence and its implementation in policy

Embracing a New Goal: A World Free of Nuclear Weapons?

- Obama and others have called for a new paradigm
 - *Goal* of a world without nuclear weapons
 - George P. Shultz, William J. Perry, Henry A. Kissinger and Sam Nunn
- How can we achieve this goal? What strategies or “roadmaps” might we follow to realistically reduce – and one day eliminate – the need for nuclear weapons?
- What role might the nuclear weapons complex play, if any?
 - Historically, weapon design enabled stockpile reductions
 - Safety, reliability, accuracy
 - Is our history a guide to the future?



Capability-Based Deterrence

The ability to reconstitute a nuclear arsenal as a form of deterrence. This form of deterrence relies on an agile and sufficiently capable infrastructure which can produce deployable weapons if needed at appropriate capacity. In this scenario, the ability to design, fabricate and deploy a deterrent that meets changing threats is paramount.*

*The majority of deterrence is gained by this capability, though not all. A small (perhaps very small – few hundred) nuclear arsenal is deployed to ensure an immediate deterrent against most potential threats, with the capability of the weapons complex providing the insurance against breakout scenarios, technological surprise, or changes in the geopolitical environment.

Capability-Based Deterrence

The idea of capability as deterrence has been suggested by many.

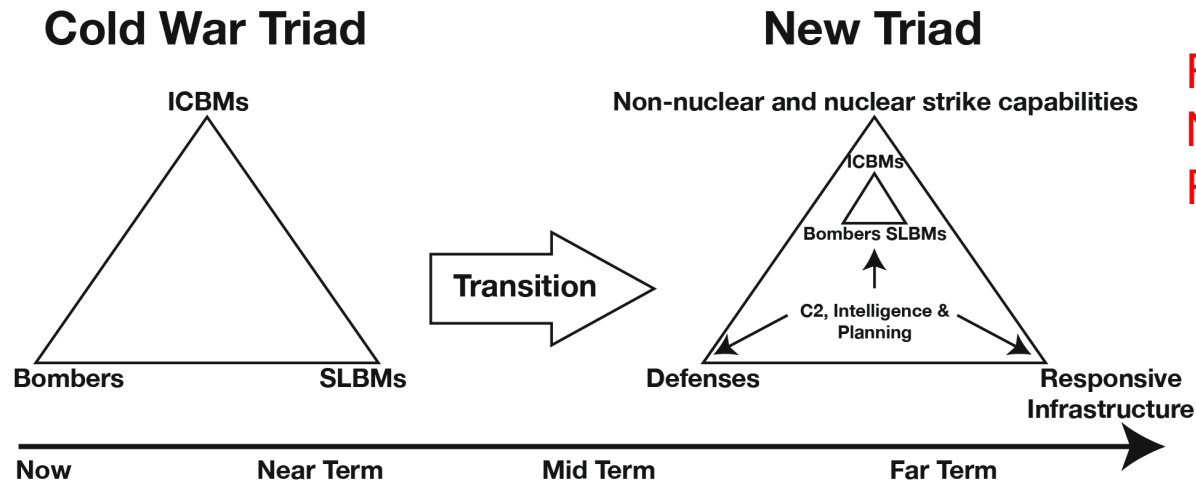
Jonathan Schell, *The Abolition*, 1984

Ted Gold and Rich Wagner, *Long Shadows and Virtual Swords*, 1990

“The fact is nuclear deterrence is increasingly hazardous and decreasingly effective. We have to change our way of thinking about it... including ways of stretching out time for decision making during a nuclear crisis and relying increasingly on an ability to reconstitute nuclear forces as a safer form of nuclear deterrence.” - George Shultz, in *A World Without Nuclear Weapons: End State Issues*, Sid Drell and James Goodby, 2009

An Evolution Towards Capability-Based Nuclear Deterrence – the Nuclear Posture Reviews

Three examinations of the role of nuclear weapons post Cold-war have occurred: 1993, 2001, 2010

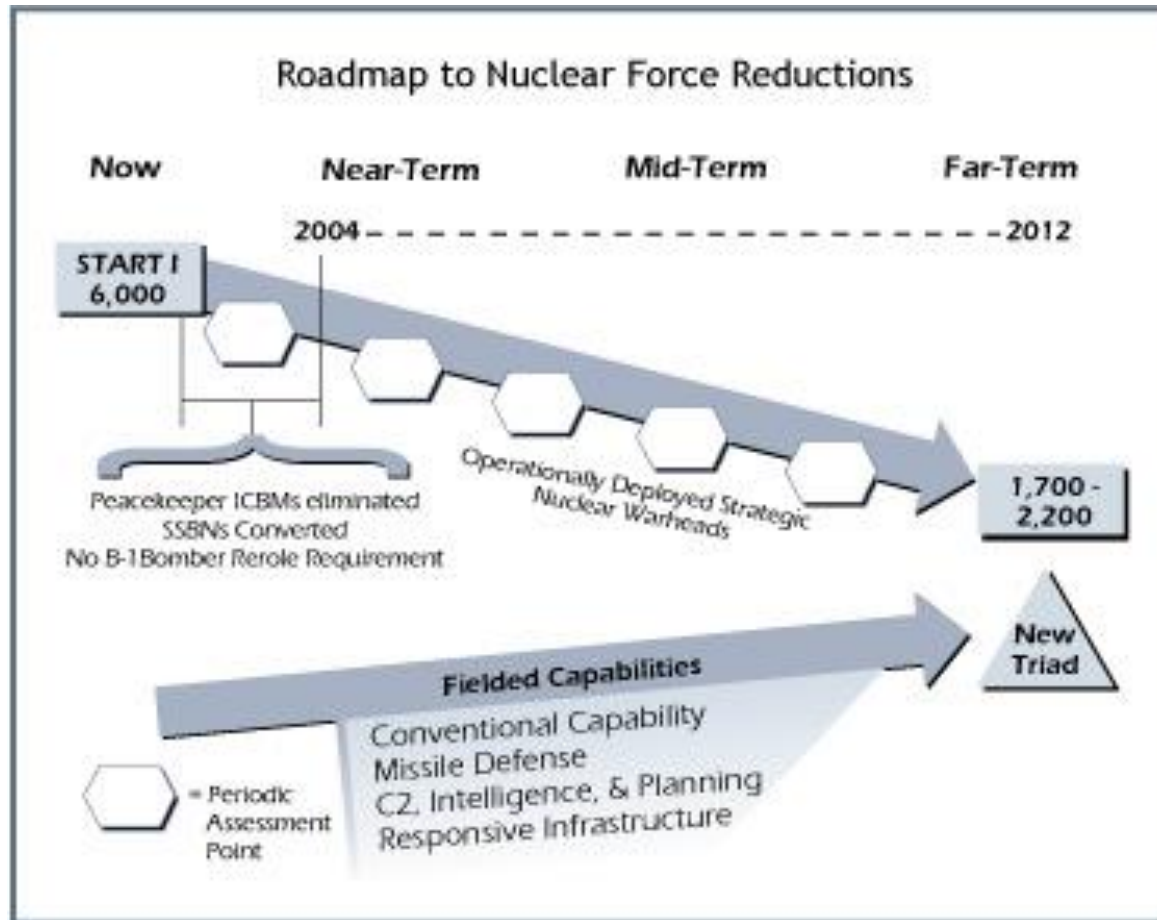


From the 2001
Nuclear Posture
Review

“First, the United States will take concrete steps towards a world without nuclear weapons. To put an end to Cold War thinking, we will reduce the role of nuclear weapons in our national security strategy, and urge others to do the same. Make no mistake: As long as these weapons exist, the United States will maintain a safe, secure and effective arsenal to deter any adversary, and guarantee that defense to our allies .” – President Obama, Prague, 2009



Capability Enabling Stockpile Reductions



From the 2001 Nuclear Posture Review

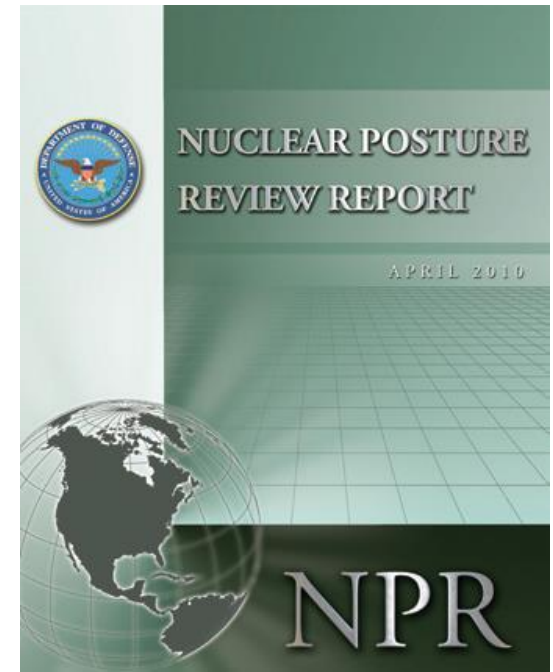
Deterrence by Capability as Policy (1)

“Once we establish a responsive infrastructure, *and demonstrate a capability to produce warheads* on a timescale in which geopolitical threats could emerge, and can respond in a timely way to technical problems in the stockpile, then we can go much further in reducing non-deployed warheads “

- Jerry Paul, Deputy Administrator, NNSA, Presentation to the Council on Foreign Relations, May 25, 2005

Deterrence by Capability as Policy (2)

“Implementation of the Stockpile Stewardship Program and the *nuclear infrastructure investments recommended in the NPR* will allow the United States to shift away from retaining large numbers of non-deployed warheads as a hedge against technical or geopolitical surprise, allowing major reductions in the nuclear stockpile. These investments are essential to facilitating reductions while sustaining deterrence under New START and beyond.”
- (2010 NPR, page 30)

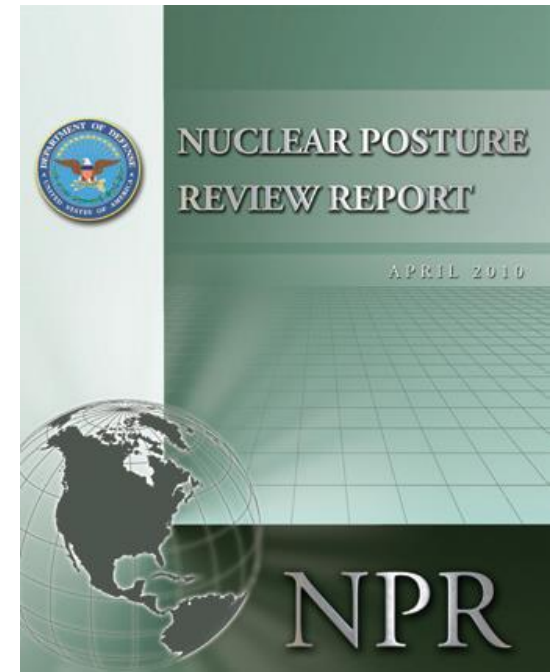


Deterrence by Capability as Policy (3)

“Increased investments in the nuclear infrastructure and a highly skilled workforce are needed to ensure the long-term safety, security, and effectiveness of our nuclear arsenal and to support the full range of nuclear security work to include non-proliferation, nuclear forensics, counter-terrorism, emergency management, intelligence analysis and treaty verification.

Such investments, over time, can reduce our reliance on large inventories of non-deployed warheads to deal with technical surprise, thereby allowing additional reductions in the U.S. nuclear stockpile and supporting our long-term path to zero.

A revitalized infrastructure will also serve to reduce the number of warheads retained as a geo-political hedge, by helping to dissuade potential competitors from believing they can permanently secure an advantage by deploying new nuclear capabilities.” (2010 NPR, page 41)



Part 2:

Assessment of Capability Based Deterrence compared to other options

A systems-analysis approach: are various forms of deterrence effective?

A joint project with Los Alamos, Sandia, and Stanford University

JC Martz, PA Stevens, L Branstetter, E Hoover, and K O'Brien, "Examination of the Role of Nuclear Deterrence in the 21st Century: A Systems Analysis Approach", LA-UR-10-03518 (2010)

Approach: a requirements-based matrix assessment of options for protecting strategic security.

Methodology:

- 1) state broad-based criteria, refine definitions, and group into 5 areas
- 2) provide a wide spectrum of postures and strategies which are evaluated
- 3) score each strategy against each criteria
 - time intensive and exhaustive!
 - definitions were critical. Common terms and understanding
- 4) Compile overall scores, varying weighting of criteria to look at resilience of strategies

Criteria and Strategies

Criteria covered 5 Broad areas:

- protect vital United States national security interests – 8 total
- provide needed national technical capabilities – 8 total
- lower nuclear risks – 11 total
- enhance United States standing and reputation – 6 total
- benefit society – 4 total

37 criteria were stated and evaluated in total

We examined 7 paradigms spanning a wide range of possibilities:

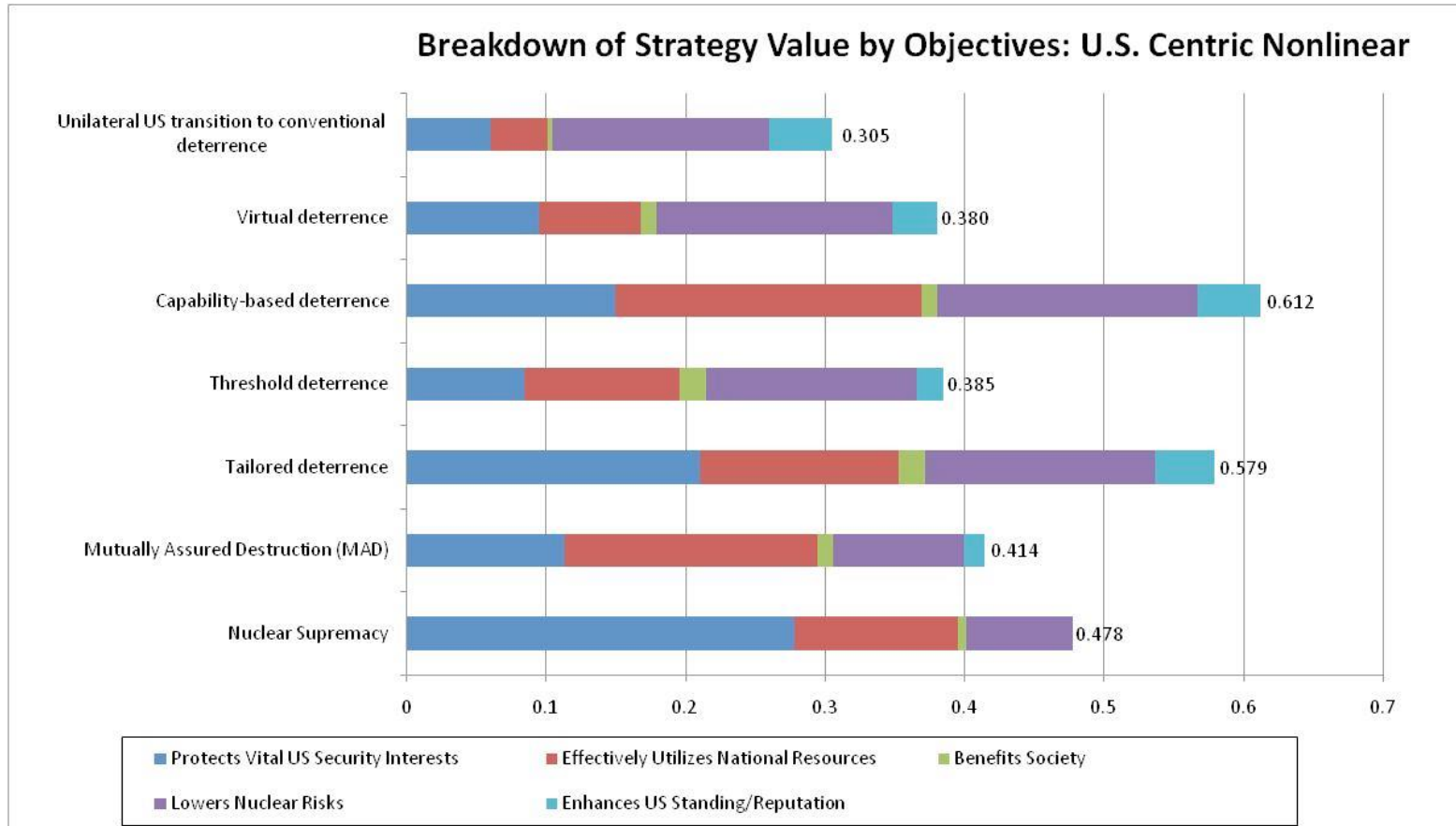
- Nuclear Supremacy
- Mutual Assured Destruction
- Tailored Deterrence
- Threshold Deterrence
- Capability-Based Deterrence
- Virtual Deterrence
- Deterrence Without Nuclear Weapons

We did not try to predict the future. Presumed the world situation as it sits today.

Example Evaluation: Protect Vital US Interests

	Meets needs (potentiality)	Assures security partners (extended deterrence)	Ensures unacceptable consequences for aggression (deters)		Disincentivizes adversary's will to develop parity (dissuades)	Defeats adversary decisively if required	Counters other countries' nuclear threat	Provides maximal flexibility in response (menu of options)	
	military		for US	for Allies					
Nuclear Supremacy (does not preclude conventional strike capability)	E: Meets military needs.	F: Security partners are irrelevant because the US can first strike anyone.	E: Yes, no question.	F: Allies are not needed.	E: Total dissuasion.	E: Defeats adversaries decisively.	E: Dominant, absolute first strike to anyone.	E: Multiple options up to nuclear weapons destruction.	9
Mutually Assured Destruction (MAD)	M: Prevents large scale wars of attrition.	F: Extended deterrence does not work; it is all or nothing.	P: It does only if your threat is credible; suicide for all.	P: Allies are not needed.	F: Failed during the arms race - Russia and the US both failed in parity.	E: By definition, it does and defeats you too.	F: Does not counter a countries capability of continued deterrence.	0 F: MAD or nothing.	0
Tailored deterrence	E: Meets exceptionally well	P: Self-interest dominates, allies may question commitment	M: Because response is tailored to deterree it is more plausible that it will actually be employed without self- inhibition. Tailoring ensures that the "suit" fits the deterer as well as the deterree.	E: if includes allies interests in what is "tailored"; P if not	M: China not seeking parity; Russia is	M: If properly assessed threat	M: If you know and are timely	P: Only as flexible as your initially assessed threats	3
Threshold deterrence	P: Fails to meet selected targets and threats (HDBT, leadership, information)	P: Very limited assurances, many scenarios are not accounted for	M: Adversary thresholds can change	P: Threshold finely tuned to given deterree; therefore, nuclear force may be insufficient for extended deterrence. Arms race unstable if extended beyond single deterree.	F: May tempt near- peers to break out	F: Asymmetric advantage if adversary dominates	F/P: Unless you specifically target nuclear weapons as your "threshold"	F: Only option is your threshold	0
Capability-based deterrence (includes a minimum deployed set)	M: If agility and force structure balance against adversary	P: Requires more trust and faith from allies	P: Effective leadtime is proportional to existing intelligence capability. Timeframe for response is inversely proportional to existing capability.	P-: Minimal deployed set insufficient to support extended deterrence concepts. Multiple parties dynamics can evolve more rapidly than capability. Intelligence is more critical with multiple parties.	P: More difficult because the delta in capabilities has, by definition, already been reduced	P: If adversary decides to aggress; no longer capability-based	M: Assumes timely detection and response	E: By definition, this is a strength of capability-based deterrence (no need to guess correctly)	9
Virtual deterrence ("emphasizes parts over factory")	P: Militarily effective if response is timely enough relative to the threat	P: response has to be timely to assure our allies.	P-: Timeframe for reponse is constrained; options for response are limited by existing parts inventory.	F+: Timeline is challenging for multiple parties. Options are predefined by existing parts inventory. Conventional capability may partially compensate.	P: Timeline to respond becomes the only obstacle to an adversary; however, only having "parts" represents a single point vulnerability	P: If timeline is consistent with threat	P: They must also be in a virtual mode, such that the timelines match	P: Stockpile mix could provide variety of mix-n- match capabilities ("plug-n- play" options possible)	3
Deterrence without nuclear weapons (zero nuclear weapons)	P: Ability to hold high-priority targets @ risk (value targets such as economic, population, power structures	P: Depends on the credibility of the US conventional deterrent capability	F: Conventional and other means of deterrence have limited capability (destruction is lesser)	F: Not plausible that conventional force will be able to overcome asymmetry if facing nuclear forces. If whole world is denuclearized then symmetry makes it more plausible; but rest of world will seek asymmetry.	F: Zero nuclear weapons will incentivize other countries to just have one and be superior. May even begin to determine (?) nuclear weapons may be superior	F: Would scale wars of attrition if nuclear weapons are not used	F: Unable to counter nuclear weapons threat due to targeting i.e. destructive power of nuclear weapons yield. Huge loss of US lives.	F: Very limited options for responsive targeting.	0

Systems Analysis: Results



Some Interesting Observations

Two options score significantly higher than others

Capability Based Deterrence

Tailored Deterrence

These 2 options are robust and insensitive to weighting of the criteria

Other options do vary with weighting, particularly those at the extremes

We welcome other views and means of assessing the criteria

Part 3:

Characteristics of an effective Capability Based Deterrent

A prominent role for NNSA and the
National Labs

Key Questions for a Capability-Based Deterrent

How agile do we need to be?

3 – 5 – 10 years?

How do we assess this?

historic weapon development times?

expert assessment?

negotiated via arms control?

What about military readiness?

Dual use delivery platforms?

Dedicated platforms?



TA-55 Plutonium Complex at Los Alamos

How will capability be perceived by –

Allies? Adversaries? The rest of the world?

Must linkage to stockpile goals and a CTBT be explicit?

Will transparency play an important role?

Do we design transparency into weapons? The complex?



Capability-Based Deterrence

Two elements are essential in enablement of this strategy:

Agility & Confidence

This are both technical requirements. Science and Engineering will dominate.

Agility

Essential to respond on a time-frame which is faster than an adversary could develop and deploy a potential threat

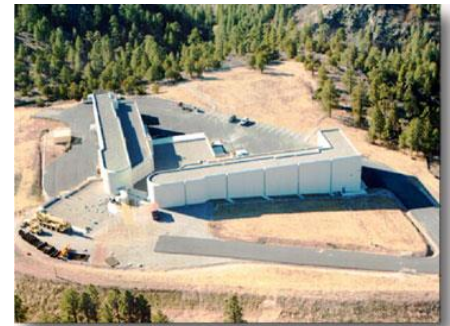
- numerous analyses of possible threats
- only 2 would require a rearmament of substantial level
 - recidivist Russia
 - expansionist China
- ~decade warning (versus minutes during Cold War)

Enabled by changes in both the weapons complex and the stockpile

Complex Transformation

ex: Reliable Replacement Warhead – RRW

ex: Life Extension Programs - LEPs



DARHT

Dual-Axis Radiographic Hydrodynamic Test facility

Capability-Based Deterrence (cont)

Confidence

Convince ourselves, our allies, and our adversaries that the capability is credible and will work when and if required.

Key element: enable continued cessation of nuclear testing

Safety/Security/Use Control = “Surety”

challenging scenarios post 9/11

goal: no nuclear yield; limited nuclear material dispersal

Many critical elements are immature:

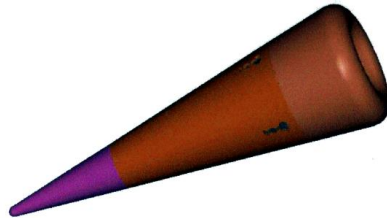
high-energy density physics

numeric issues in calculations

lack of data on high-rate and extreme materials properties

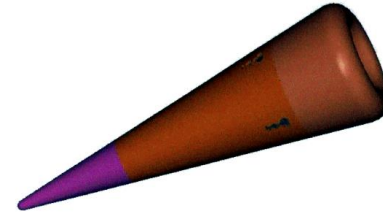
many others...

A Comparison of Future Requirements to the Legacy Stockpile



Legacy Design

- Optimized for high yield-to-weight ratio
 - test-based certification
- Limited security features
- Exotic materials
- Hard to manufacture components
- Frequent surveillance
- Dismantlement difficult



Future Requirements

- Optimized for high margin-to-uncertainty ratio
 - science-based certification
- Enhanced security
- Ease of manufacture
 - Eliminate exotic materials
 - Alternate materials
 - Reduced process steps
- Reduced surveillance requirements
- Improved dismantlement and material disposition

Agile, assured ability to produce enables a capability-based deterrent

How might we rebalance risk/benefit in the weapons complex?

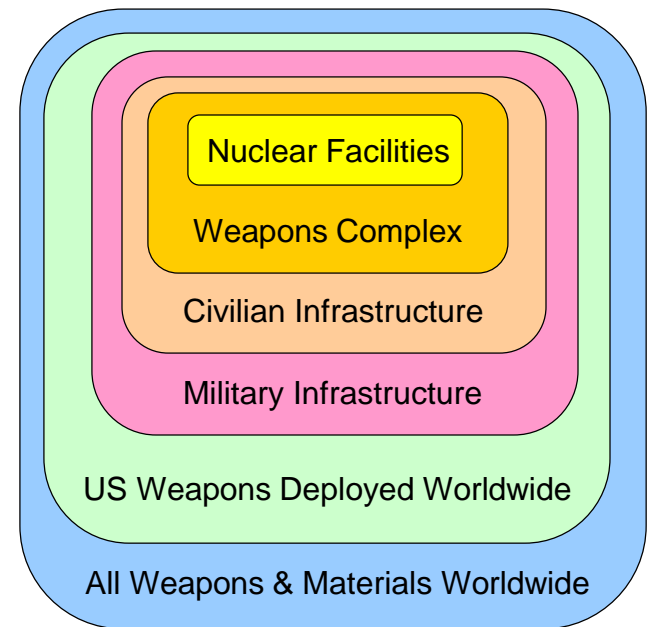
Many have noted the increasing compliance regulations in the nuclear weapons complex – safety, security, environment

“Over the last... I would say now sixteen years, the regulatory environment at these laboratories has become so risk averse that we essentially can't get work done anymore.”

We have to change the working environment to allow people to get their work done. These places nowadays look more like prisons than they do like university campuses or something in between.”

- Sig Hecker, Senate Testimony, April 30, 2008

Extent of Risk Assessment



Accept slightly increased risk at the center for dramatic reductions of risk elsewhere

Want to know more?

“An Examination of the Role of Nuclear Deterrence in the 21st Century: A Systems Analysis Approach” LA-UR-10-03518

“Reconstitution as Deterrence”, J.C.Martz, Actinide Research Quarterly, Number 1, May 2011, pg. 1 (2011)

“The Nuclear Weapons Complex as Deterrent: Challenge and Issues”, J.C. Martz, Nuclear Weapons Journal Vol 4 Issue 1, pg. 30 (2010)

“Detonation: From the Bottom Up”, J.C.Martz, National Security Science, July 2014, pg. 3-14 (2014)

Backups

A closer look at paradigms

Nuclear Supremacy

Large reliance on nuclear capabilities, new weapon options and effects, and diverse and redundant deployment options. Includes conventional strike capabilities

Mutual Assured Destruction

Cold-war strategy in which capable, minutes-ready nuclear forces are deployed and intended to counter a peer-adversary and remain survivable in the event of a first strike, surprise attack.

Tailored Deterrence

Based on Elaine Bunn's article (Can deterrence be tailored? Strategic Forum, 225, Jan 2007). Careful examination of each potential threat, and a proportionate, broad-spectrum response is deployed spanning nuclear, conventional, economic, and diplomatic options.

Threshold Deterrence

UK Cold War Model. An identified, specific asset of an adversary is held at certain risk, no effort to remain proportionate to adversary forces.

A closer look at paradigms (cont)

Capability-Based Deterrence

Presumes that sufficient time is available to counter an emergent or recidivist adversary (at least several years). Relies on agile and confident capability to produce nuclear stockpile in conjunction with bilateral deployed and reserve stockpile reductions. Retains weapons complex and a small, ready force to counter most potential threats.

Virtual Deterrence

Moves away from deployed weapons to components, parts, and systems in storage and available for reassembly. Emphasizes controlled storage of components and parts, and does not develop new weapons or factories.

Deterrence Without Nuclear Weapons

Explicitly does away with US Nuclear weapons stockpile in an accelerated time frame. Efforts are made to induce other states to do the same, but is unilateral in nature. Moves protection of US interests to non-nuclear means including enhanced conventional forces, economic, and diplomatic.

Recent Developments in Nuclear Deterrence

- April 2009: Obama embraces the goal of a “world free of nuclear weapons”
 - October 2009 Nobel Peace Prize
- November 2009: Congressional Strategic Posture Commission releases its report
 - Weapons still serve a deterrent role
 - Can accomplish this at reduced numbers
 - Weapon complex infrastructure has been neglected
- April 2010: New Nuclear Posture Review is released
- April 2010: Russia/US sign “New START” Treaty
 - Overall limit 1550 “deployed, strategic weapons”
 - Submitted to the Senate for ratification (Perry provides first testimony)
 - Ratified by the Senate on Dec. 22, 2010
 - Entered into force on Feb. 5, 2011
- April 2010: International Nuclear Security Summit
 - 44 World Leaders, most since UN founding in the US
 - Agreements to limit fissile material spread
- May 2010 NPT Review Conference
- March 2016 Nuclear Security Conference
- 2017 Trump Administration – new Nuclear Posture Review



Issues in the Current Nuclear Weapon Stockpile

- Obama and others have called for a new paradigm
 - Goal of a world without nuclear weapons
 - George P. Shultz, William J. Perry, Henry A. Kissinger and Sam Nunn
- What role might the enduring and/or modernized nuclear stockpile and nuclear weapons complex have in this objective?
A potentially very important one!
 - Historically, weapon design enabled stockpile reductions
 - Safety, reliability, accuracy
- Is our history a guide to the future?

